

**THE ENBRIDGE CONSUMERS GAS “STEAM SAVER” PROGRAM
AN UP-DATE AND ANALYSIS OF RESULTS FOR THE PERIOD
APRIL, 1998 TO JAN 31, 2001**

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1.0 A Brief History

Steam Plants consume approximately 30% of the total natural gas consumed in Ontario. Enbridge has approximately one third (400 plants) of all the large steam plants in Ontario in its territory. These plants consume approximately 1.9 Billion Cubic Metres (67 BCF) of gas annually.

The Enbridge steam saver program was first implemented in April, 1998. The following results pertain to all of the Boiler Plant Audits (41) and other programs implemented in the three years since then. In total, 80 customer sites are involved.

2.0 Natural Gas Prices

The main purpose of the Steam Saver Program is to identify energy saving opportunities for our customers and to provide technical assistance, incentive grants, equipment leasing and other services in order to facilitate the implementation of these projects. The current average burner-tip price of gas for large volume customers is \$ 0.30 / CU M (\$ 8.49 per MCF). This figure has been used to calculate savings and the financial pay-back for all projects to date.

The average burner-tip price of natural gas for large volume customers has increased during the report period as follows:

1998	\$ 0.10 per CU M	or	\$ 2.83 per MCF
1999	\$ 0.12 per CU M	or	\$ 3.40 per MCF
2000	\$ 0.16 per CU M	or	\$ 4.53 per MCF
2001	\$ 0.30 per CU M	or	\$ 8.49 per MCF

Consequently, the savings and financial payback for projects has improved dramatically. The rate at which projects are being implemented is beginning to increase.

3.0 Steam Saver Programs –Description of Current Programs

3.1 The Boiler Plant Audit and Performance Test – Since April, 1998

This program has been operating for almost three years. During this period, it has been changed and improved to meet customer demands. The basic service includes combustion tests on boilers and an analysis of energy saving projects. To this has been added an analysis of the economic performance of the steam plant, a calculation of the cost of steam and a mass and heat balance analysis for the steam plant. The boiler plant audit is available **for a fee** to plants having fuel consumption greater than 2.5 million cubic metres (90 MCF) of natural gas per year.

3.2 The Steam Pressure Reduction Program- Since October, 1998

Steam Pressure Reduction in Large Central Heating plants can yield savings of 2% to 6% of the total natural gas consumed. Enbridge assists customers to perform pressure testing and to monitor the fuel consumption results. Six projects have been implemented to date.

3.3 The Steam Trap Survey Program – Since October, 1999

Enbridge subsidizes steam trap testing by qualified consultants such as Spirax-Sarco, Preston Phipps(Armstrong) and Nutech(TLV). This program was introduced in 2000 and 38 trap surveys were completed. The current payback on trap replacement and repair projects is 0.5 years or less.

3.4 The New Boiler Plant Program - Since October, 1999

Customers planning new boiler plants or boiler replacements are eligible for incentive grants if they implement a range of efficiency measures. Measures include the correct sizing of boilers, economizers, blow-down heat recovery, Metering and Monitoring fuel and steam and regular combustion testing.

3.5 Metering and Data Acquisition Program. – Since January, 1999

This program has been a hard sell to date. Energy savings are difficult to calculate directly and the capital cost is high. Recently, because of the high price of fuel, there is an increased interest in metering and monitoring. This program provides incentive grants based on 2.5% of the fuel saving for a boiler plant which implements a specified minimum Metering and Data Acquisition system.

Steam Saver Programs –Description of Current Programs (Continued)

3.6 Possible New Program – The Insulation Survey

The first pilot insulation survey was completed by **Energy Saving Audits Inc.** of Minnesota at the Unilever-Lipton Plant in Rexdale, ON. The results of this survey demonstrate the economics of improving the insulation levels in piping, tanks, valves and boiler parts is attractive at current gas rates. We may implement a new energy efficiency program around insulation.

3.7 The Combustion Tune-up Program- (Since December, 2000)

This program provides incentive grants to customers who contract with existing boiler service companies, to perform regular combustion tests and tune-ups. Enbridge pays an incentive grant per boiler, depending on the boiler size, to customers who complete two tests and tune-ups per year for two years. This program is aimed at showing customers the benefits of combustion maintenance. It is too early to assess the results of this program.

3.8 Chemical Treatment for Boiler and Steam Systems

Steam system professionals are poorly versed in chemical treatment technology than any other aspect of boiler and steam system activity.

Most third party steam consultants have little knowledge of boiler chemistry. Operators and plant managers rely almost entirely on the expertise of the water treatment suppliers to manage their plants.

Companies such as Nalco, Betz Dearborn, Klenzoid and Ashland (Drew Chemical) have much to offer in the identification of savings opportunities. Many advances in chemical treatment are being implemented by these companies but not reported to the wider stakeholders.

The potential to save energy lies in projects such as:

- Better control of basic chemical treatment (quality control). This pertains to the basic control of corrosion and scaling in boilers.
- Automatic blow-down systems based on on-line monitoring of conductivity or other parameters.
- Automatic control of entire chemical treatment systems including data acquisition and reporting.
- FDA approved pipe coatings for food and hospital applications.
- Reverse osmosis and other pre-treatment systems.
- Training of operating personnel and steam professionals.

At Enbridge, our plan is to understand this technology better and to develop specific programs around boiler and steam system chemical treatment.

RESULTS TO DATE- SUMMARY

The following information summarizes the results of the Steam Saver Program. Details are available in EXCEL spread-sheets **SscustdataNoNameJan01.XLS** and **SSPROJ-JAN-31,2001.XLS** which accompany this document.

4.0 BOILER PLANT AUDITS

4.1 Identified Fuel Saving Projects 3-year period:

4.2 Number of Plant Audits Completed for Period:	41
4.3 Total Annual Gas Consumption, all plants:	333,560,856 CU M/YR
4.4 Total Annual Gas Bill, all plants:	\$ 100,068,257
4.5 Annual Fuel Savings Identified (natural gas only):	40,059,976 CU M/YR
4.6 Annual Fuel Savings – Dollars @ \$ 0.30/CU M	\$12,017,993
4.7 Number of projects identified-all plants	203
4.8 Total Capital investment for 203 projects	\$ 13,452,654
4.9 Average Payback for 203 Projects	1.12 Years

4.10 Implemented Fuel Saving Projects-Boiler Plant Audits:

4.11 Number of Projects Implemented to Date	39
4.12 Annual Fuel savings Implemented	10,713,569 CU M/YR
4.13 Annual Fuel Savings-Dollars @ \$ 0.30/CU M	\$ 3,214,071

4.13 OTHER PROGRAMS-Identified Savings=6,932,243 CU M/YR

Program	No. of Projects Completed	Savings Implemented CU M/YR	Dollar Savings Implemented
4.14 Steam Pressure Reduction Program	6	1,814,490	\$ 544,347
4.15 Steam Trap Surveys	38	2,327,712	\$ 698,314
4.16 New Boiler Plants	2	400,000	\$ 120,000
4.17 Metering and Data Acquisition for boiler plants	2	476,000	\$ 142,800
4.18 Total-Other Programs	46	5,018,202	\$ 1,505,461

4.19 TOTAL IDENTIFIED SAVINGS, ALL PROGRAMS = 46,992,219 CU M/YR

4.20 Total Annual Savings Identified:	46,992,219 CU M/YR
4.21 Total Annual Savings Identified-Dollar Value	\$ 14,097,666
4.22 Total No. of Projects Identified:	251
4.23 Total No. of Projects Implemented:	71
4.24 Total Annual Savings Implemented to Date	15,731,771 CU M/YR
4.25 Total Annual Savings Implemented-Dollar Value	\$ 4,719,532

5.0 ANALYSIS OF RESULTS

Refer to the attached Spreadsheets SscustdataNoNameJan01.XLS and SSPROJ-JAN-31,2001.XLS

Energy Management Consultants from Enbridge Consumers Gas visit customers daily and many projects outside the Steam Saver Program are proposed, analyzed and implemented. These results analyze major activities pertaining only to the Steam Saver Program over the past three years.

5.1 Total Identified Savings at approximately 80 sites

Boiler Plant Audits and Other Programs have identified **46,992,219 CU M/YR** of savings on total annual natural gas consumption of **343,060,856 CU M/YR**. The potential annual dollar savings is **\$ 14,097,666** if all projects are implemented.

There were **251 projects identified** and the simple financial payback on these projects is estimated to be **1.1 years** based on the current price of natural gas.

Identified savings represent **13.7%** of total natural gas consumption. Other savings such as water, electricity and chemicals and maintenance are not tracked by the program but are identified and included when calculating the benefits of individual projects.

5.2 Identified Savings - Boiler Plant Audit Vs. Other Steam Saver Programs

Boiler Plant Audits account for **40,059,956 CU M/YR** of Identified savings on total fuel gas volume of **343,060,856 CU M/YR** or **11.7 %** of total natural gas consumption.

Other Steam Saver Programs account for **6,932,243 CU M/YR** or identified savings on total natural gas volume of **343,060,856 CU M/YR** or **2.0 %** of total natural gas consumption.

5.3 Total Implemented Savings

The total annual fuel savings through Steam Saver projects implemented to date is **15,731,771 CU M/YR**. This represents **33.5% of the fuel saving projects identified and 4.5% of the total fuel bill for these sites**. It is expected that the implementation rate will increase with the motivation provided by higher natural gas prices.

5.0 ANALYSIS OF RESULTS (Continued)

5.4 Energy Saving Projects by Type of Project

Table # 4 provides a breakdown of the identified savings and implemented savings according to the type of project. To date, 12 categories of project have been defined. This breakdown provides an indication of where to look for savings in a steam system.

5.5 Heat Recovery and Economizer Projects (Item 3, table 4)

This category includes feed-water economizers, condensing economizers, blow-down heat recovery, and waste steam and water heat recovery.

This is the largest category with **11,809,158 CU M/YR** of identified savings or **25% of total identified savings**. The current financial payback on these projects is 1.1 years. The implementation rate to date is lower than average at **17% of savings identified**.

5.6 Steam Traps and The Steam Distribution System (Item 5 and item 10, table 4)

Steam distribution improvements offer the next largest potential for savings in the boiler plant and steam system. This category represents **10,775,132 CU M/YR** of savings or **23% of all savings identified**.

It is likely however that this is really the largest category. The steam trap survey program has only been operating for one year and we expect that year two of this program will push it into the number one position.

The implementation rate for these projects is about average to date. These projects are mainly maintenance activities and the current financial payback is less than 4 months. We expect to see a major increase in the implementation rate in these projects. Because of the specialized nature of the technology, the analysis and implementation of these projects is mainly in the hands of the major steam trap companies, namely, in our area Spirax Sarco, Armstrong and TLV.

5.0 ANALYSIS OF RESULTS (Continued)

5.7 Boiler Plant Capital Projects (Item # 2 , table 4)

This category includes various capital projects but the main items are the replacement of old boilers and the installation of small boilers for summer loads. The average age of steam boilers in Ontario is 27 years. Many boilers are over 40 years old. The tendency of the boiler plant owner is to continually repair the old boiler just to keep it going. The New boiler plant program was implemented in October, 1999 for the purpose of encouraging replacements and additional efficiency measures **at the design stage** of the new plant.

Total savings identified in this type of project were **7,909,603 CU M/YR** or **17% of all identified savings**. The problem with these projects is that they are capital intensive and have a long payback period. Until this year, the average payback was over 7 years. It is now 3.1 years.

5.8 Combustion Improvements (Item # 1, Table 4)

Combustion improvements identified represent **6,076,909 CU M/YR** in savings or **13% of all savings identified**. This figure is **1.8% of total natural gas consumed**. This figure is derived by comparing the "as-found" combustion efficiency with the attainable efficiency for the type of boiler being tested.

These improvements range from a simple boiler tune up to major burner repairs and a re-vamp of boiler controls in large boilers. For the most-part, combustion improvement is an on-going maintenance item in boiler plants. The average payback is 0.4 years and the implementation rate is high at 50%.

5.9 Operating Changes in boiler Plant and Steam System (Item 4, Table 4)

Operating changes include better practice measures such as reduced de-aerator venting, reduced blow-down (better TDS control), Shut down boilers operating on low fire, Assess operation of backpressure turbines and shut down if feasible.

Ultimately, the implementation of these measures is the responsibility of the boiler plant management because they require a change in daily operating practices and at times, a change in the general attitude within the plant.

The fuel savings in this category are **2,407,192 CU M/YR** or **5%** of the total savings identified. In spite of the short financial payback, the implementation rate is low (**27%**) because for most projects it is difficult to verify the continuation of the measure.

ANALYSIS OF RESULTS (Continued)

5.10 Building HVAC Improvements (Item #7, Table 4)

Enbridge has a separate program to assess HVAC systems in industrial plants. The projects which have been generated by the Steam Saver Program in this category tend to be items which are obvious when the steam distribution system is studied as part of a boiler plant audit. This category includes such items as temperature set-back controls, increased recirculation in make-up air units, close doors during winter and turn steam unit heaters off during summer.

The fuel savings for this category are 2,535,190 CU M/YR or 5.4% of the total identified savings. The implementation rate has been zero to date, mainly because this measure has not been given enough emphasis within for follow-up the Steam Saver Program.

5.11 Steam Pressure Reduction - Central Heating Plants (Item 9, Table 4)

This program is aimed at central heating plants which require low pressure steam (15PSIG) for building heating but generate steam at up to 250 PSIG.

The majority of Hospital, University and Government steam plants are oversized, especially during the off season, allowing for the reduction of steam pressure which saves energy through lower boiler stack temperatures, reduced radiation loss and reduced leakage in traps and other locations. Technical problems resulting from reduced pressure or staged pressure reductions depending on outdoor temperature, have been minimal.

To date, tests and technical support have been provided at six sites. The average saving is about 3% of the total fuel input. The total identified **savings 1,814,490 CU M/YR**. The implementation rate has been 100%.

5.15 Steam Plant Metering and Monitoring Program (Item 12, Table 4)

To date, this program has been a hard sell. For small and medium sized boiler plants, the existing level of metering and instrumentation is low. Many plants do not have steam flow meters and some do not even meter fuel input.

The capital cost is high when starting from scratch and the savings are difficult to justify in advance. With the increase in gas prices there has been an increase in interest .

To date, one project has been implemented generating **400,000 CU M/YR** in savings.

ANALYSIS OF RESULTS (Continued)

5.16 Insulation Improvements (Item 7, Table 4)

To date, projects involving insulation improvements have been generated on a casual basis, where obvious problems exist, and not by a rigorous survey approach. The first comprehensive survey has been completed at Unilever (Lipton) Toronto and the results are positive in terms of the amount savings and financial payback (2 years).

The present Steam saver Program has identified **885,650 CU M/YR** of savings with a financial payback of 1.0 years. We have not followed up these projects to determine whether they have been implemented but will be doing so in this fiscal year.

**TABLE 4
SUMMARY OF IDENTIFIED SAVINGS BY CATEGORY OF PROJECT**

NO.	TYPE OF PROJECT	NO. OF PROJECTS	ANNUAL SAVINGS IDENTIFIED	ANNUAL SAVINGS IDENTIFIED	Percentage Of Identified Savings	Percentage Of Total Gas Consumed
		IDENTIFIED	CU M / YR	\$		
1	Combustion Improvements	45	6,076,909	\$1,823,073	12.9%	1.8%
2	Boiler Room Capital Projects	43	7,384,603	\$2,215,381	15.7%	2.2%
3	Heat Recovery and Economizer Projects	37	11,809,148	\$3,542,744	25.1%	3.4%
4	Operating Changes in Boiler Room	22	4,305,097	\$1,291,529	9.2%	1.3%
5	Steam Distribution and Condensate Improvements	37	6,658,379	\$1,997,514	14.2%	1.9%
6	Building HVAC Changes and Capital Projects	7	2,535,190	\$760,557	5.4%	0.7%
7	Insulation Improvements	3	885,650	\$265,695	1.9%	0.3%
8	Other Projects	9	405,000	\$121,500	0.9%	0.1%
TOTAL Boiler Plant Audits		203	40,059,976	\$12,017,993		
9	Steam Pressure Reduction	6	1,814,490	\$544,347	3.8%	0.5%
10	Steam Trap Survey Program	38	4,116,753	\$1,235,026	8.8%	1.2%
11	New Boiler Plant Program	2	525,000	\$157,500	1.1%	0.2%
12	Metering and Monitoring Program	2	476,000	\$142,800	1.0%	0.1%
TOTAL-ALL PROGRAMS		251	46,992,219	\$14,097,666	100.0%	13.7%

6.0 CONCLUSION-STEAM SAVER AUDITS AND OTHER STEAM PROGRAMS TO Jan 31, 2001

6.0 The identified savings to date (3 year period) are 47 million CU M/YR. This represents 13.7% of the total fuel consumed for 41 boiler plant audits and another 39 sites where special programs have been applied. The implemented savings are 15.7 million CU M/YR of natural gas. This represents 4.5% of the total fuel consumed.

6.1A comprehensive approach is required to identify savings in each boiler plant and steam system. There are many different savings opportunities. **There is no panacea** but if one were to pick the areas for the largest savings with high investment returns the choice would be 1.) Projects pertaining to **steam traps, steam distribution and condensate return**. 2.) Projects pertaining to **heat recovery**, mainly in the boiler plant. Together these account for nearly 50% of the total identified savings. These technical areas are universal, that is, they are present in all steam systems regardless of end user.

6.2 The results shown in this report are representative but are not a random, statistically valid sample. Some programs have only one year of history while the Boiler Plant Audit has been operating for three years. We expect that **new programs** such as the Steam Trap Survey and the Insulation Survey will begin to generate increased savings.

6.3 The Implementation of projects requires direct representation in most cases. Customers are unable to evaluate savings, capital investments and the validity of vendor proposals in most cases. Constant follow-up is required to encourage the implementation of projects.

6.4 The **rising cost of fuel** will cause a large increase in demand for the service of auditing and identifying savings and assisting in implementation.

6.5 There is a **shortage** of qualified third party consultants and experts to meet the current demand.

6.6 For **comprehensive boiler plant audits**, the best strategy is to target larger facilities. As a gas utility we must provide similar services to all market segments however, the economics of this activity in the Industrial Market favours large plants. The identified savings per dollar of audit cost is much higher for the larger plants. Furthermore, the follow-up time and effort is greater for small plants.

6.7 Contrary to the above conclusion **special programs** such as the steam trap survey can be broken out and economically applied to smaller plants. We have done trap audits of sites with as few as 25 traps.